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Large Hadron Collider
Magnet Division Procedure

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Title: LHC D3 IFS Installation

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REVISION RECORD

Rev. No.	Date	Page	Subject	Approval
A	8/4/04		Initial Release	

1 Scope:

This procedure describes the steps to install the D3 IFS feed through assemblies into cryostatted magnets.

2 Applicable Documents:

14060323	D3 Cryostatted Magnet Assembly
14019011	D3 Wiring Diagram
LHC-MAG-R-1051	Electrical Testing of Level & Temperature Sensors
RHIC-MAG-Q-1004	Discrepancy Reporting Procedure

3 Requirements:

3.1 Material/Equipment:

None

3.2 Safety Precautions:

3.2.1 All lifting of the cryostatted magnet shall to conform to Appendix A.

3.2.2 No welding shall take place unless all welding screens are in place around the welding station, and all personnel not directly involved with the welding process are outside the screens. Any personnel inside the screens shall wear protective gear to prevent eye injury, and shall be clothed to prevent burns caused by intense ultra-violet light.

3.2.3 Operators shall be trained by their cognizant technical supervisor and qualified in the operation of the required welding equipment.

3.2.4 All lifting and handling operations requiring overhead crane operations shall be performed by holders of valid Safety Awareness Certificates. Operators shall also be briefed in the use of the appropriate lifting device by the Cognizant Engineer or Technical Supervisor.

3.2.5 Technicians shall be instructed by their cognizant technical supervisor in the operation of the required electrical test equipment and the electrical testing procedures. They shall be familiar with the latest revisions of the applicable documents referenced in section 2. In addition, some of these tests require the technician to have special training.

3.2.6 Some of the electrical test procedures have specific safety requirements. The technicians performing these specific tests shall rigorously follow all the safety requirements listed as well as those prescribed by the BNL ES & H Standard.

3.2.7 Hypot testing poses a Class "C" electrocution hazard. At least two properly trained technicians must be present to perform this testing. When testing, a trained technician shall be stationed at any point where the item under test is accessible to unauthorized people, and barriers shall be set up. Signs shall be posted reading "DANGER HIGH VOLTAGE" and warning lights shall be turned on.

4 Procedure

4.1 Mechanical Preparations

4.1.1 Weld an extension ring to each feedthrough.

4.1.2 Leak check the weld of the extension ring on each feedthrough. Leak rate shall not exceed 2×10^{-10} Std cc He /Sec.

4.1.3 Temporarily mount the feedthroughs to the magnet cryostat using the mounting bracket. Be sure the feedthrough will be oriented properly based on the dash number of the magnet.

4.2 Electrical Connections For Each Feedthrough

4.2.1 Install NOMEX wire guard discs onto top of cryostat port. Strip the insulation from the end of each of the cables in the harness so that the individual insulated wires will reach the pins on the feedthrough.

4.2.2 For each wire, slip the two pieces of shrink sleeve over the wire, strip the insulation from the end of the wire, slip the conductor into the proper pin and solder in place.

4.2.3 Position the inner piece of shrink tube as shown on the assembly drawing and shrink it with a heat gun.

4.2.4 Position the outer piece of shrink tube as shown on the assembly drawing and shrink it with a heat gun.

4.2.5 When all the wire connections have been made, neatly coil and bundle the wires so that the feedthrough can be lowered into place.

4.2.6 Wrap the Nomex guard around the wires. Interlock the two slots to form a ring and secure with Kapton tape.

4.3 Final Installation

4.3.1 Lower the feedthroughs into place. Be sure it is positioned properly based on the dash number of the magnet.

4.3.2 Temporarily restrain the feedthroughs using 3 small tack welds each.

NOTE

The feedthroughs must not be permanently welded until the weld of the IFS cups to the cryostat port flange has been leak checked during prep for cold test

4.3.3 Perform electrical checks on each cold mass as noted in Appendix B.

NOTE

The following section is performed <u>after</u> the vacuum vessel is pumped down and leak checked in preparation for cold test. This will verify the vacuum integrity of the weld of the IFS cups to the cryostat port flanges.

4.3.4 Use the small tube in the feedthrough to purge the feedthrough with argon and weld the feedthrough in place.

4.3.5 Install and weld the cap on the small purge tube.

4.3.6 Perform electrical checks on each cold mass as noted in Appendix B.

4.4 Feed Through Box Installation

4.4.1 On each cold mass, install the connector box, PC board, and cover on the feed through. Leave the two cables coming from the master box unconnected.

4.4.2 Perform electrical checks on each cold mass using the feed through box connectors as noted in Appendix B.

4.4.3 Install the two umbilical cables connecting the feed throughs.

4.4.4 Perform electrical checks on each cold mass as noted in Appendix B.

5 Quality Assurance Provisions

5.1 The Quality Assurance provisions of this procedure require that the technician shall be responsible for performing all operations in compliance with the procedural instructions contained herein and the recording of the results on the production traveler.

5.2 The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with RHIC- MAG-Q-1004.

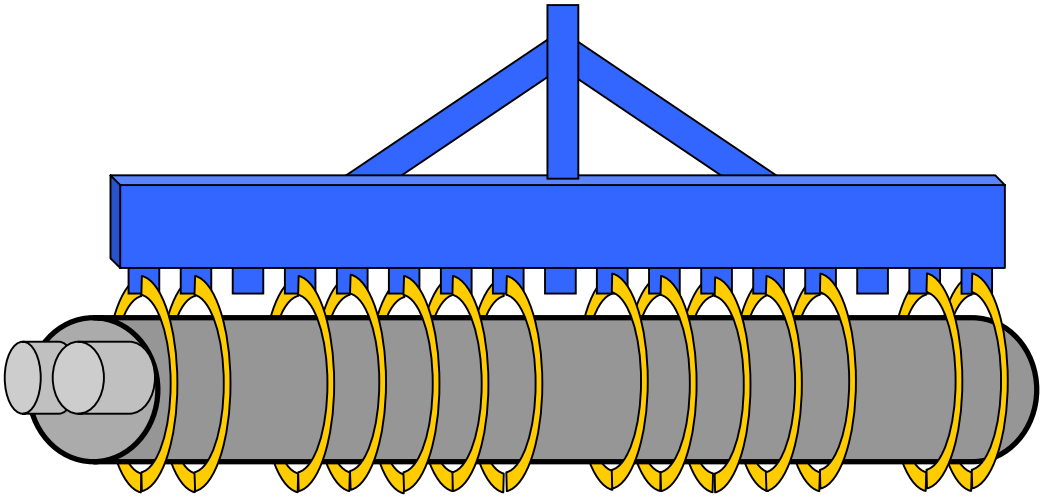
5.3 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000, where applicable.

Appendix A - Lifting Scheme for Cryostatted D3 Magnet

CAUTION

Make sure load is equally distributed on 14 of 17 lifting lugs (center lug and lugs 3 from each end are not used).

Using 14 slings and Lifting Beam 25-1782.02 as shown below to move the magnet assembly. Verify all slings are of equal length.



Magnet Assembly Rigging

Appendix B - Electrical tests

NOTE

See Table 1 and Table 2 of this appendix for connector layouts on each cold mass

1. Connect beam tube, all quench protection resistors & iron to each other and to ground. Connect coils together and perform 5 kV Hypot between coils and ground per RHIC-MAG-R-7242 and RHIC-MAG-R-7243.

NOTE

The leakage current must be less than 50 μa.

2. Connect beam tube, coils & iron to each other and to ground. Perform 2.5kV Hypot between each of two quench protection resistor circuits and ground per RHIC-MAG-R-7242.

NOTE

The leakage current must be less than 50 μa.

3. Connect beam tube, coils & iron to each other and to ground. Perform 5kV Hypot between each of two quench protection resistor circuits and ground per RHIC-MAG-R-7242. Record the leakage.

4. Connect beam tube, all coils, iron & quench protection resistors to each other and to ground. Perform 2kV Hypot between each warm-up heater circuit and ground per RHIC-MAG-R-7242.

NOTE

The leakage current must be less than 50 μa.

5. Perform DC resistance tests per RHIC-MAG-R-7320 to measure voltage drops across the entire magnet winding and the voltage drop across each individual coil. Perform measurements using regular and redundant voltage taps individually.

Resistance - Section 1 (lead → midplane):	1.543-1.606
Resistance - Section 2 (lead → lead):	3.109-3.172

6. Perform complete measurements of RL&Q per RHIC-MAG-R-7228. Measured values should be:

   R: 3.109-3.172 Ω
   L: 27.19-28.30 mH
   Q: 3.636-4.444

7. Perform resistance check of Level Probes as noted in LHC-MAG-R-1051.

8. Perform resistance check of Cold Mass Temperature Sensors as noted in LHC-MAG-R-1051.

9. Perform resistance check of Warm-Up heaters. Allowable resistance is 95-105Ω

10. Perform resistance test between normal and redundant voltage tap wire at each point. Resistance to be 320Ω - 480Ω.

11. Perform resistance test on each of two Quench Protection Resistor circuits. Allowable resistance is:

Prior to umbilical connection:	2.8-3.4 Ω
After umbilical connection:	5.6-6.8 Ω

Appendix B - Table 1
Master Feed-Through Box (Right Hand Magnet)

Description	Connector ID	Feed-through ID	
Level Probe – 1	C32-4	LT821 I-	
Level Probe - 1	C32-3	LT821 I+	
Level Probe - 1	C32-2	LT821 U-	
Level Probe - 1	C32-1	LT821 U+	
Level Probe - 2	C32-8	LT822 I-	
Quench Protection RH Magnet – Circuit #1	P31-1	YT311 I+	Use these entries prior to connection of umbilicals. After connection, use entries below
Quench Protection RH Magnet – Circuit #1	L31-1	YT311 I-	
Quench Protection RH Magnet – Circuit #2	L31-4	YT312 I+	
Quench Protection RH Magnet – Circuit #2	P31-2	YT312 I-	
V-Tap Upper 1st	P30-2	EE211	
V-Tap Upper 2nd	D31-6	EE212	
V-Tap Mid 1st	D31-7	EE231	
V-Tap Mid 2nd	D31-8	EE232	
V-Tap Lower 1st	D31-9	EE251	
V-Tap Lower 2nd	D31-10	EE252	
Warm-Up Heater Circuit 1	C31-2	EH821 I-	
Warm-Up Heater Circuit 1	C31-1	EH821 I+	
Warm-Up Heater Circuit 2	C31-4	EH822 I-	
Warm-Up Heater Circuit 2	C31-3	EH822 I+	
Yoke Temperature Sensor 1	C30-4	TT821 I-	
Yoke Temperature Sensor 1	C30-3	TT821 I+	
Yoke Temperature Sensor 1	C30-2	TT821 U-	
Yoke Temperature Sensor 1	C30-1	TT821 U+	
Yoke Temperature Sensor 2	C30-8	TT822 I-	
Yoke Temperature Sensor 2	C30-7	TT822 I+	
Yoke Temperature Sensor 2	C30-6	TT822 U-	
Description	**Connector ID -** *Master Box*		
Quench Protection Circuit "A"	P31-1		Use these entries after connection of umbilicals
Quench Protection Circuit "A"	P31-3		
Quench Protection Circuit "B"	P31-4		
Quench Protection Circuit "B"	P31-2		
	P30-1		

Note: *Quench Circuit "A" consists of circuits YT311 from each magnet wired in series. Quench Circuit "B" consists of circuits YT312 from each magnet wired in series. The identifiers "A" and "B" are arbitrary and serve merely to designate the separate circuits for testing purposes.*

Appendix B - Table 2
Slave Feed-Through Box (Left Hand Magnet)

Description	Connector ID	Feed-through ID	
Level Probe – 1	C32-4	LT821 I-	
Level Probe - 1	C32-3	LT821 I+	
Level Probe - 1	C32-2	LT821 U-	
Level Probe - 1	C32-1	LT821 U+	
Level Probe - 2	C32-8	LT822 I-	
Level Probe - 2	C32-7	LT822 I+	
Level Probe - 2	C32-6	LT822 U-	
Level Probe - 2	C32-5	LT822 U+	
Quench Protection LH Magnet Circuit #1	L31-2	YT311 I-	*
Quench Protection LH Magnet Circuit #1	L31-1	YT311 I+	*
Quench Protection LH Magnet Circuit #2	L31-4	YT312 I-	*
Quench Protection LH Magnet Circuit #2	L31-3	YT312 I+	*
V-Tap Upper 1st	D31-1	EE111	
V-Tap Upper 2nd	D31-2	EE112	
V-Tap Mid 1st	D31-3	EE131	
V-Tap Mid 2nd	D31-4	EE132	
V-Tap Lower 1st	D31-5	EE151	
V-Tap Lower 2nd	L30-1	EE152	*
Warm-Up Heater Circuit 1	C31-2	EH821 I-	
Warm-Up Heater Circuit 1	C31-1	EH821 I+	
Warm-Up Heater Circuit 2	C31-4	EH822 I-	
Warm-Up Heater Circuit 2	C31-3	EH822 I+	
Yoke Temperature Sensor 1	C30-4	TT821 I-	
Yoke Temperature Sensor 1	C30-3	TT821 I+	
Yoke Temperature Sensor 1	C30-2	TT821 U-	
Yoke Temperature Sensor 1	C30-1	TT821 U+	
Yoke Temperature Sensor 2	C30-8	TT822 I-	
Yoke Temperature Sensor 2	C30-7	TT822 I+	
Yoke Temperature Sensor 2	C30-6	TT822 U-	
Yoke Temperature Sensor 2	C30-5	TT822 U+	

(*) *Use these entries prior to connection of umbilicals. After connection of umbilicals, refer to Table 1 for these circuits*